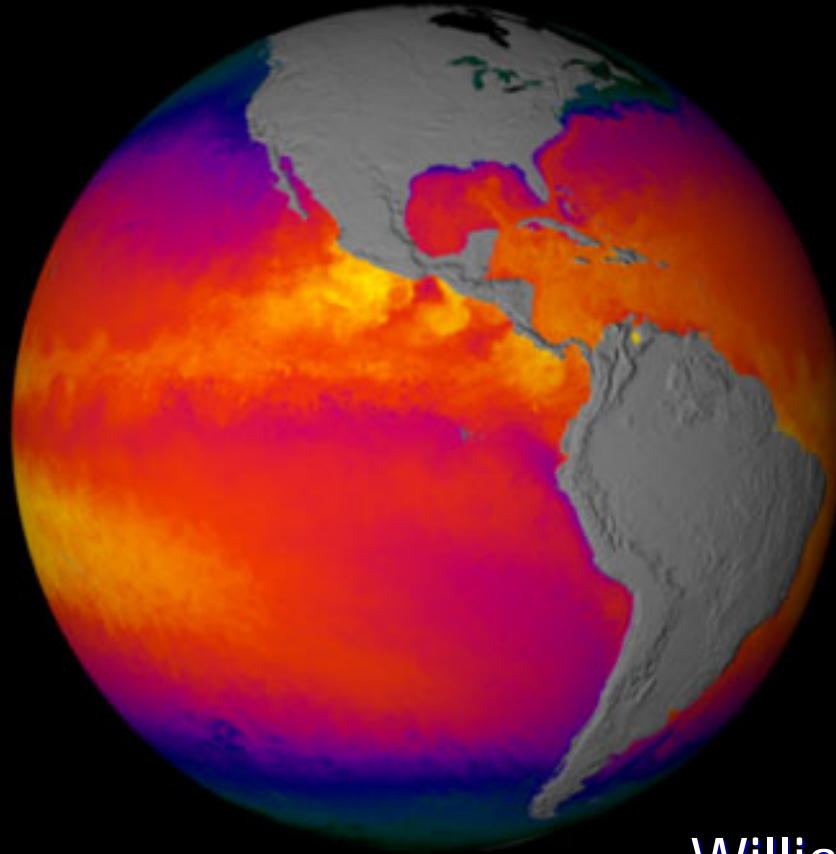
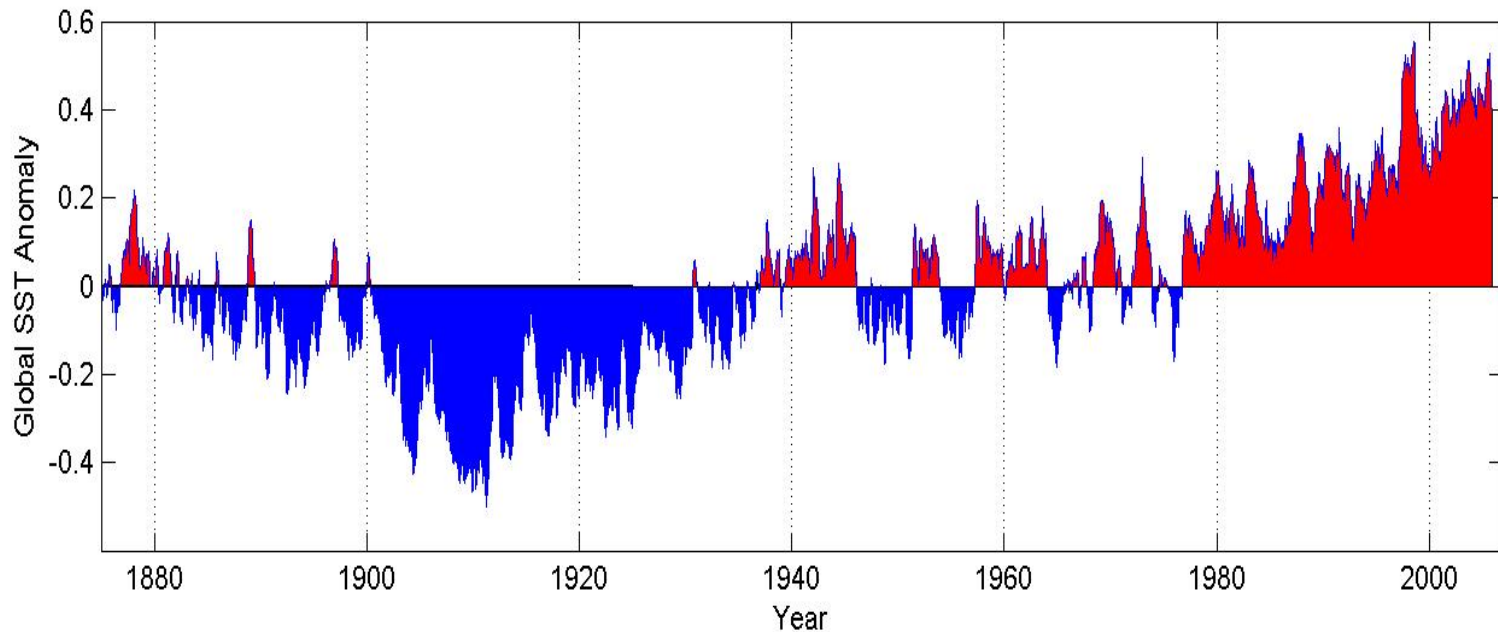


# Ocean Climate and Marine Ecosystems: Indicators of Change in Structure and Productivity



William J. Sydeman, Ph.D.  
President/Senior Scientist  
Farallon Institute for Advanced Ecosystem Research

# Global Sea Surface Temperature Anomaly, 1880-2005



Courtesy Francisco Chavez, MBARI

# Potential Ecological Impacts

- Range expansions/contractions
- Physiology
- Timing - "Phenology" (earlier/later)
- Complex ecological interactions – predator/prey interactions

# Compelling Biological Signals

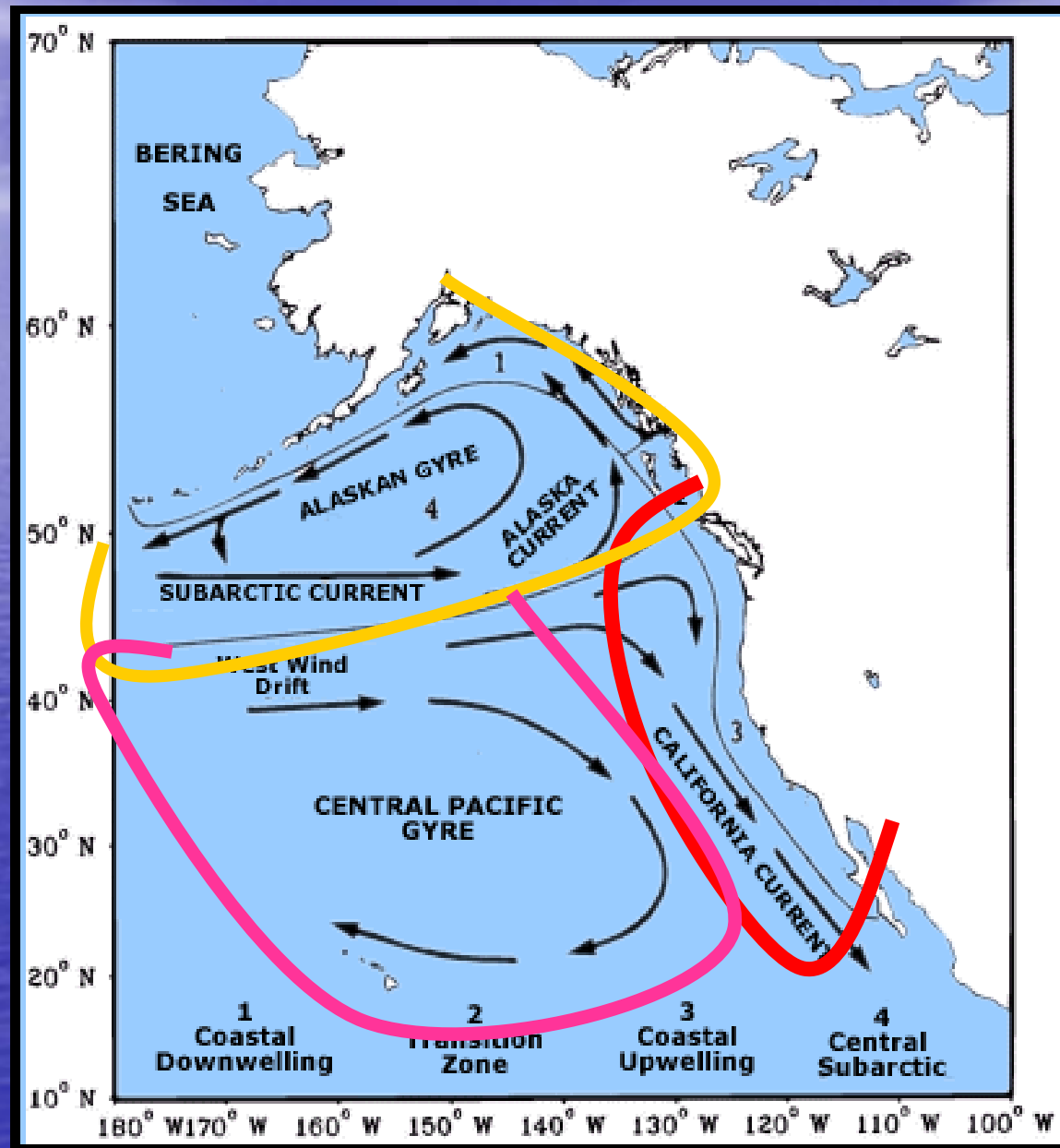


**Humboldt Squid**

Tom Mattusch



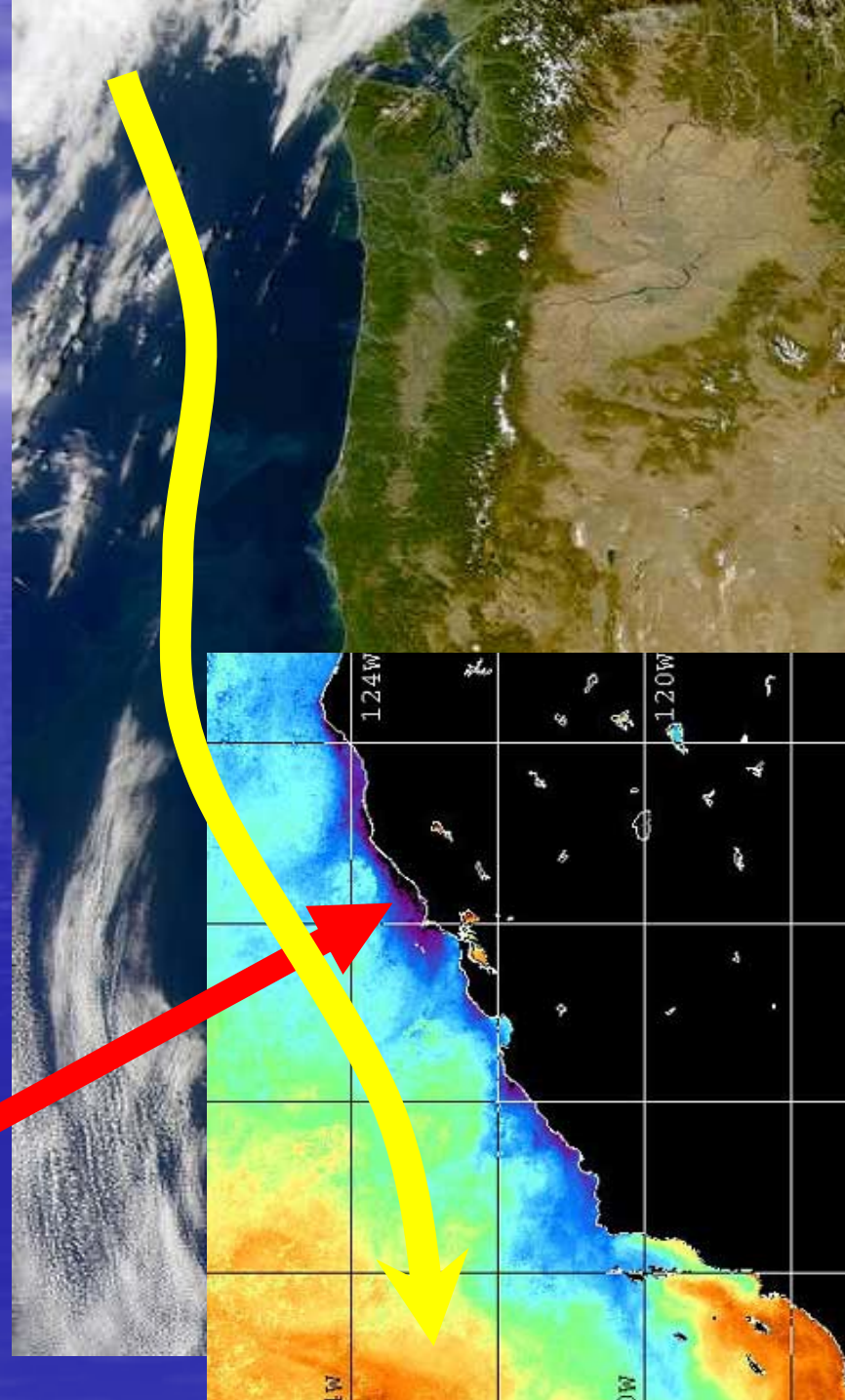
# Large Marine Ecosystems, NE Pacific



## The CA Current LME – How Does it Work?

- (1) California Current – offshore “river in the sea” – brings water from Gulf of Alaska
- (2) Many promontories – sites of coastal “upwelling”

Pt. Arena/Pt. Reyes Upwelling Cell



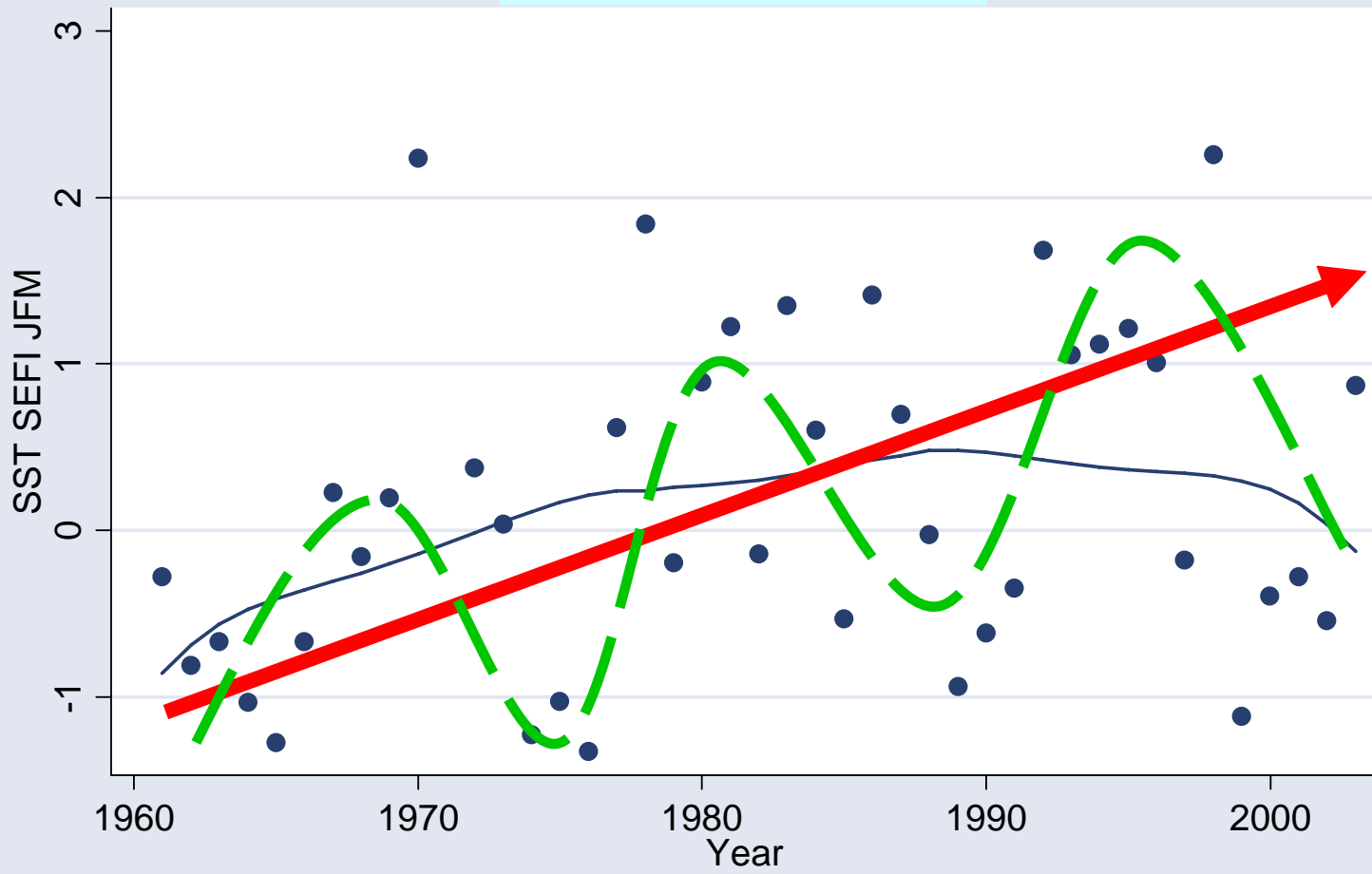


a living laboratory: 40+ years



**SE Farallon Island, Field Station, USFWS & PRBO**

# Wintertime: Key; Temp, 1960-2003



bandwidth = .8



# Like the stock market?

- fluctuations, but increasing overall
- but, should we invest?

A star indicator...

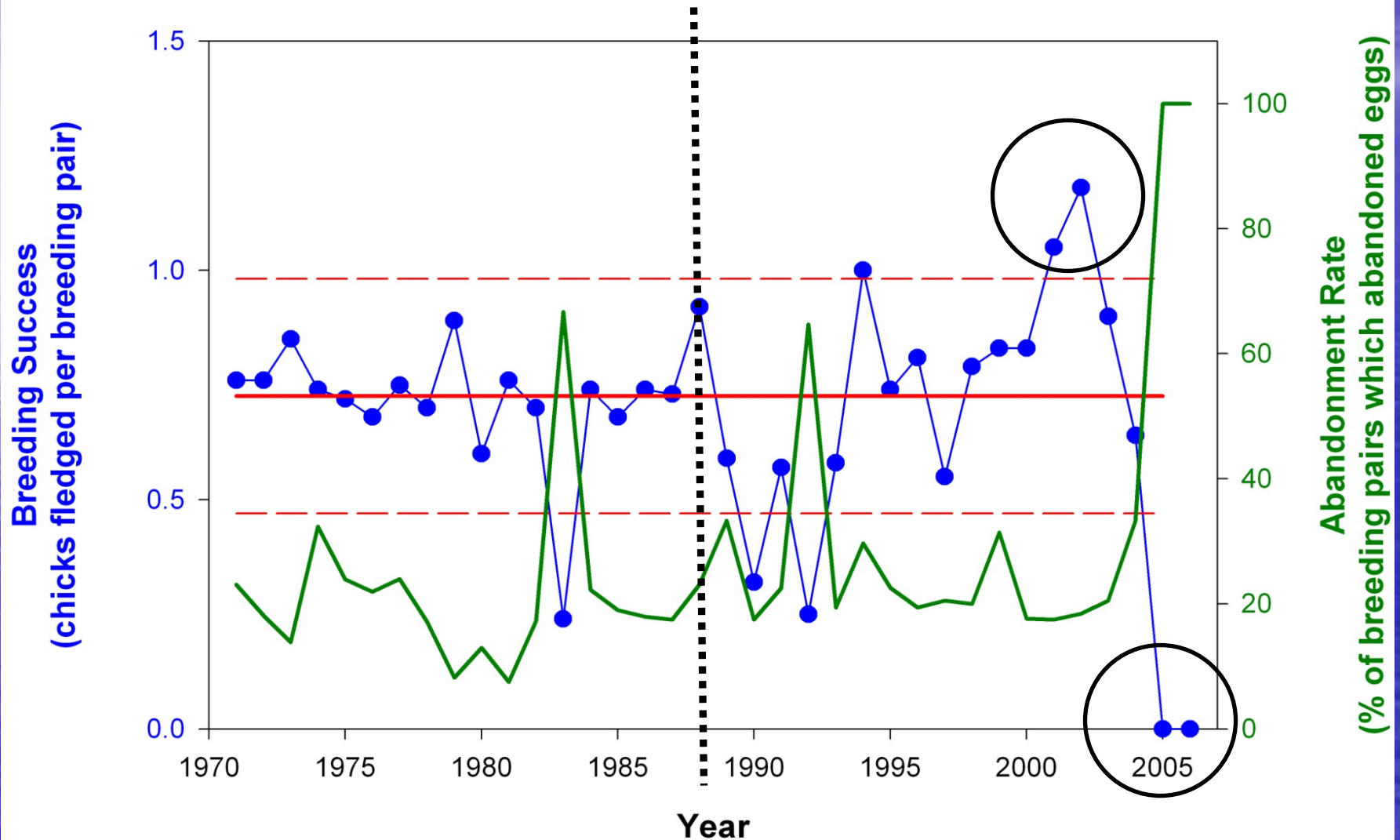


**Cassin's Auklet**

Photo: Duncan Wright



# Breeding Success and Abandonment, 71-06





# Auklet Breeding Success by Decade

<u>Decade</u>	<u>Mean</u>	<u>CV(%)</u>
1971-1980	0.745	11.0
1981-1990	0.642	32.5
1991-2000	0.695	30.4
2001-2006	0.628	82.6

**Krill, 80% of the diet**

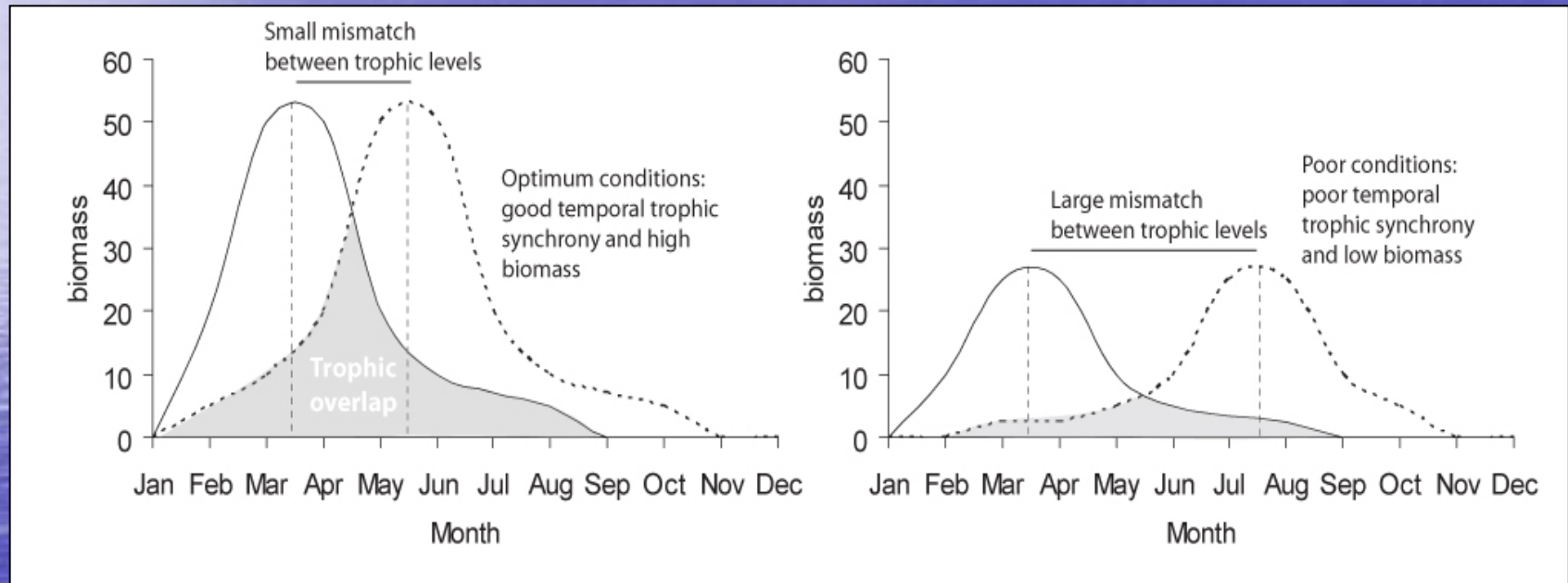


# Blue Whales and Krill Swarms in Monterey Bay





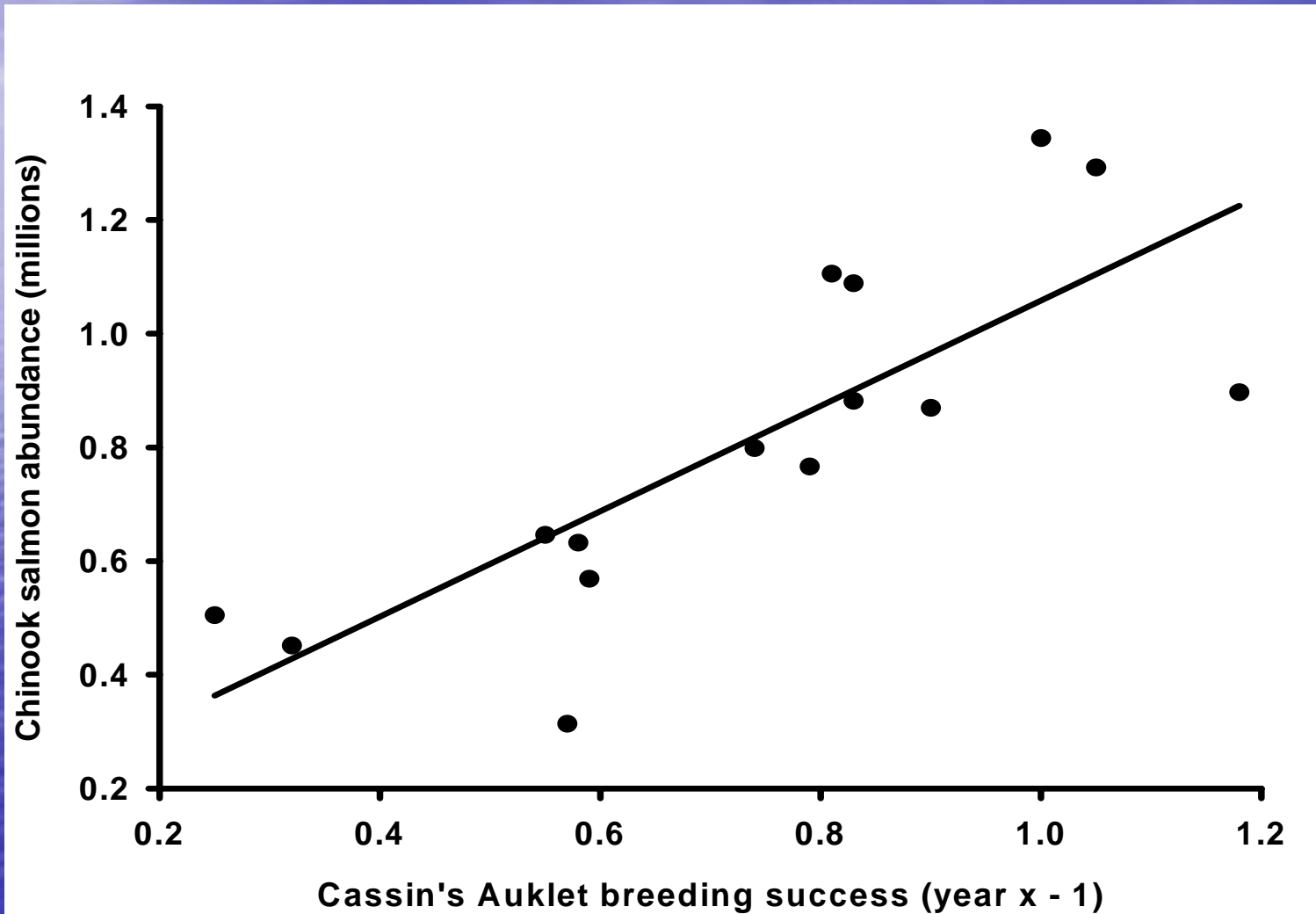
Most likely not enough food, or not at the right time (new CA SeaGrant).



# "Canaries" of the CA Current?



# Auklets Predict Chinook Salmon



Roth, Mills, Sydeman (Canadian J. Fisheries Aqua. Sci. 2007)



# Summary

- Compelling biological changes, ecosystem oceanography, food web
- Late 1980s/1990s a tipping point?
- Trophic mismatching -- "endangered ecosystems"
- Are these changes acceptable?

# Farallon Institute



- Center for Marine Ecosystem Science (climate and fishing)
- Collective for Scientists Committed to Integrative Ecosystem Analyses
- Document, Model, Communicate, Provide Recommendations
- Comparative Approach (Peru Current, Bering Sea, Gulf of Alaska, etc.)